2. **Presentation: Update on National Fire Protection Association (NFPA) Codes with respect to Healthcare Emergency Power**

Facilitator: Walt Vernon, Mazzetti (or designee)

- Discussion on the evolution of the NFPA codes (NFPA 99, 70, and 110) for fuel cells and microgrids for healthcare emergency power systems, including the elimination of the idea of emergency power
- Discussion and public input

MAZZETTI

Evolution of National Codes vis a vis On-Site Generation

September 10, 2020

Technology & Needs Evolving

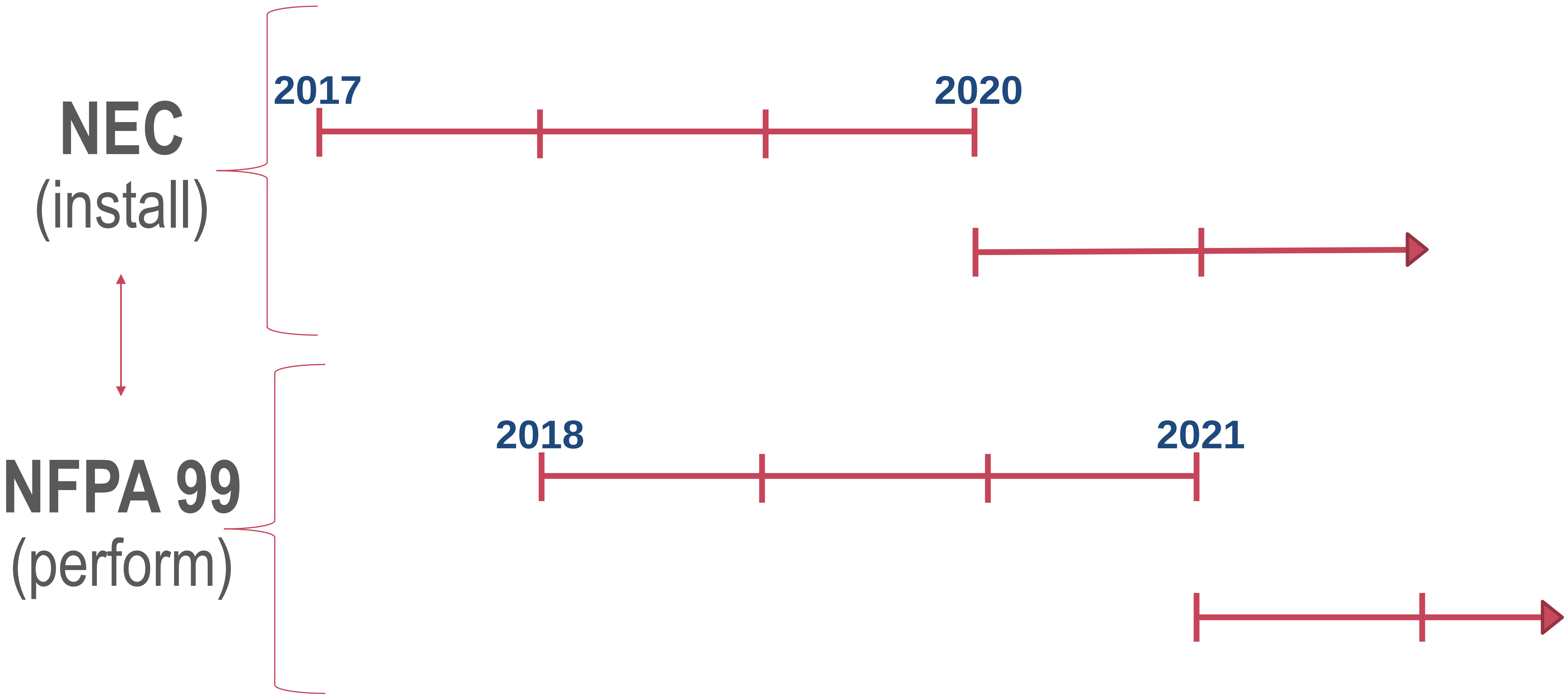
- Improved **distributed generation** options
- Improved **energy storage** options
- Improved **intelligence**
- Changing **needs for resilience**
- Changing **utility regulations** and markets

What's the big deal??

Haven't we been doing this already??

Regulations, PRACTICE, more slowly

- **NFPA 99** (Healthcare)
- **NFPA 70** (National Electrical Code)
- **NFPA 110** (Generators)
- **CMS**??????


NEC
(install)
2017
2020
NFPA 99
(perform)
2018
2021

Fuel Cells (History)

NFPA 99 – 2012

6.7.1.4 Fuel Cell Systems. Fuel cell systems shall be permitted to serve as the alternate source for all or part of an essential electrical system, provided the conditions in 6.7.1.4.1 through 6.7.1.4.6 apply.

6.7.1.4.1 Installation shall comply with NFPA 853.

6.7.1.4.2 N+1 units shall be provided where N units have sufficient capacity to supply the demand load of the portion of the system served.

6.7.1.4.3* Systems shall be able to assume loads within 10 seconds of loss of normal power source.

6.7.1.4.4 Systems shall have a continuing source of fuel supply, together with sufficient on-site fuel storage for the essential system type.

6.7.1.4.5 Where life safety and critical portions of the distribution system are present, a connection shall be provided for a portable diesel generator.

6.7.1.4.6 Systems shall be listed for emergency use.

NFPA 70 – 2020, CEC

517.30(B)(2) Fuel Cell Systems.

Fuel cell systems shall be permitted to serve as the alternate source for all or part of an essential electrical system, provided the following conditions apply: [**99:**6.7.1.4]

(1)Installation of fuel cells shall comply with the requirements in Parts I through VII of Article 692 for 1000 volts or less and Part VIII for over 1000 volts.

Informational Note: For information on installation of stationary fuel cells, see NFPA 853-2015, *Standard for the Installation of Stationary Fuel Cell Power Systems*.

(2) N + 1 units shall be provided where N units have sufficient capacity to supply the demand load of the portion of the system served. [**99:**6.7.1.4.2]

(3) Systems shall be able to assume loads within 10 seconds of loss of normal power source. [**99:**6.7.1.4.3]

(4) Systems shall have a continuing source of fuel supply, together with sufficient on-site fuel storage for the essential system type. [**99:**6.7.1.4.4]

(5) Where life safety and critical portions of the distribution system are present, a connection shall be provided for a portable diesel generator. [**99:**6.7.1.4.5]

NFPA 110 – 2022

COMING SOON!!

Microgrids
(Past, Present, Future)

NFPA 70 (NEC) 2017 ed – Article 712

N

ARTICLE 712
Direct Current Microgrids

Part I. General

712.1 Scope. This article applies to direct current microgrids.

712.2 Definitions.

Direct Current Microgrid (DC Microgrid). A direct current microgrid is a power distribution system consisting of more than one interconnected dc power source, supplying dc-dc converter(s), dc load(s), and/or ac load(s) powered by dc-ac inverter(s). A dc microgrid is typically not directly connected to an ac primary source of electricity, but some dc microgrids interconnect via one or more dc-ac bidirectional converters or dc–ac inverters.

Article added in 2017 Edition.

NFPA 70 (NEC) 2017 ed – ARTICLE 705

ARTICLE 705
Interconnected Electric Power Production Sources

Part I. General

705.1 Scope. This article covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity.

Informational Note: Examples of the types of primary sources include a utility supply or an on-site electric power source(s).

705.2 Definitions.

Interactive Inverter Output Circuit. The conductors between the interactive inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution network.

Microgrid Interconnect Device (MID). A device that allows a microgrid system to separate from and reconnect to a primary power source.

Microgrid System. A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source.

Inclusion of AC microgrids – Parallel to PRIMARY Source

NFPA 70 (NEC) 2020 ed – ARTICLE 705

705.2 Definitions.

The definitions in this section shall apply within this article and throughout the *Code*.

PCs [1] SR-8146 Hide Legislative

Microgrid Interconnect Device (MID).

A device that ~~allows~~ enables a microgrid system to separate from and reconnect to operate in parallel with a primary power source.

Informational Note: Microgrid controllers typically are used to measure and evaluate electrical parameters and provide the logic for the signal to initiate and complete transition processes. IEEE Std 2030.7-2017, *IEEE Standard for the Specification of Microgrid Controllers*, and IEEE Std 2030.8-2018, *IEEE Standard for the Testing of Microgrid Controllers*, provide information on microgrid controllers. IEEE Std 1547-2018, *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, provides information on interconnection requirements.

Microgrid System.

A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source.

Informational Note: The application of Article 705 to microgrid systems is limited by the exclusions in 90.2(B) (5) related to electric utilities. Additional information may be found in IEEE 1547, IEEE 2030.7, and IEEE 2030.8.

Refined definition of microgrid.

NFPA 99 – 2021

6.10 Health Care Microgrids. (Reserved)

6.10.1 General Requirements.

6.10.1.1 Applicability. (Reserved)

6.10.1.2* Purpose.
The purpose of Section 6.10 shall be to describe requirements for multiple-source health care microgrid systems, ac or dc, utilized as all or a portion of EPSSs for health care facilities.

A.6.10.1.2
Health care facilities are increasingly implementing various on-site generation using a wide variation in technologies. These designs optimize the use of different sources both on and off site and provide numerous advantages, including resilience, efficiency, lowered operating costs, and reduced environmental impact. Health care microgrids with sophisticated controls and bundles of sources and storage assets can provide better outcomes than the conventional design that envisions a “normal” and an “emergency” source.

6.10.1.3* Campuses.
Health care microgrids shall be permitted to serve individual buildings or campuses consisting of several buildings.

A.6.10.1.3
Areas served by health care microgrids should be identified.

6.10.1.4 Non–Health Care Buildings.
Health care microgrids shall be permitted to serve buildings that fall into multiple use categories as described in Chapter 4 .

NFPA 99 – 2021

6.10.2 Sources.

6.10.2.1
All sources shall meet the installation and maintenance requirements of the applicable NFPA code.

6.10.2.2
Any combination of generation, storage, or transformation assets shall be permitted to serve as the essential power source (EPS) for all or a portion of health care microgrids.

6.10.3 Reliability.

6.10.3.1
Health care microgrid systems shall be designed with sufficient reliability to provide effective facility operation consistent with the facility's emergency operations plan.

6.10.3.2*
Health care microgrid system components shall not be compromised by failure of the normal source.
A.6.10.3.2
A method for determining reliability for a health care microgrid can be found in IEEE's 3006 standard series *(see listed IEEE references in D.2.7)* and in NFPA 70B .

6.10.4 Interconnection to an Electrical Utility.
Health care microgrids that are interconnected to an external electrical utility shall comply with regulations relevant to the serving utility.

NFPA 99 – 2021

6.10.5 Distribution System. (Reserved)

6.10.6* Control System.
Health care microgrid control systems shall comply with the requirements of this subsection.

A.6.10.6
The health care microgrid controller is a decision-making software and/or hardware. The scheduling of health care microgrid distributed energy resources (DER) in grid-connected and island modes is performed by the controller based on economic and reliability considerations. The controller determines the health care microgrid's interaction with the utility grid, the decision to switch between grid-connected and island modes, frequency regulation and voltage control, and optimal operation of local resources. It also provides any decisions on load curtailment and shifting.

6.10.6.1* Network Segregation.

A.6.10.6.1
Health care microgrid systems monitored remotely should include safeguards to mitigate malicious control of or damage to the health care microgrid.

6.10.6.1.1
Health care microgrid control system networks shall be segregated from other networks.

6.10.6.1.2
Intelligence and memory of health care microgrid control systems shall not be dependent on off-site resources.

6.10.6.2 Source Monitoring. (Reserved)

NFPA 99 – 2021

6.10.6.3 Design.
The design of health care microgrid control systems shall include a sequence of operations for manual controlling of sources in the event of system failure.

6.10.6.4 Controller Backup Power.
Health care microgrid controllers shall have a dedicated battery backup having a minimum 90-minute capacity.

6.10.6.5 Annunciation.

6.10.6.5.1
Health care microgrid control systems shall be capable of providing readouts that indicates which sources are operating.

6.10.6.5.2
The amount of power provided to the health care microgrid by each source shall be visible at all times.

6.10.6.6 Security. (Reserved)

6.10.7 Commissioning.
Health care microgrid systems shall be commissioned in accordance with their sequence of operations.

6.10.7.1 Verification of Means and Methods.
Health care microgrid system installers or commissioning agents shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems are in proper working condition.

NFPA 99 – 2021

6.10.7.2 Commissioning Plan.
Commissioning plans shall include the following:
(1) An overview of the commissioning process developed specifically for the health care microgrid and its controller to be installed and a narrative description of the activities to be conducted
(2)* Roles and responsibilities for all those involved in the planning, design, construction, installation, and operation of the health care microgrid
A.6.10.7.2(2)

This should include all those involved in the planning, design, construction, installation, and operation of each source and control within the health care microgrid.

(3) Means and methods whereby the commissioning plan will be made available during the implementation of the health care microgrid project
(4) Plans and specifications necessary to understand the installation and operation of the health care microgrid and all associated components, operational controls, and safety systems
(5) A detailed description of each activity to be conducted during the commissioning process, who will perform each activity, and at what point in time each activity is to be conducted
(6) Procedures to be used in documenting the proper operation of the health care microgrid and all associated components, operational controls, and safety systems
(7) Guidelines and format for a commissioning checklist, relevant operational testing forms, and necessary commissioning
(8) Means and methods whereby facility operation and maintenance staff will be trained on the system
(9) Identification of personnel qualified to service, maintain, and respond to incidents involving the system

6.10.7.3 Commissioning Report.
A commissioning report documenting the commissioning process and the results shall be provided.

NFPA 99 – 2021

6.10.7.3.1
The commissioning report shall be prepared by the health care microgrid system commissioning agent and summarize the commissioning process, the operation of the system, the associated operational controls, and the safety systems.

6.10.7.3.2
The commissioning report shall include the final commissioning plan and the results of the commissioning process, as well as a copy of the plans and specifications associated with the as-built health care microgrid system design and installation.

6.10.7.3.3
The commissioning report shall include any issues identified during commissioning and the measures taken to resolve them.

6.10.8 Inspection, Testing, and Maintenance.

6.10.8.1
The health care microgrid system shall be inspected, tested, and maintained by qualified personnel.

6.10.8.2
All health care microgrid components shall be inspected and maintained in accordance with manufacturers' instructions or annually, whichever occurs first.

6.10.8.3
Health care microgrid system components shall be tested in accordance with the manufacturers' requirements.

6.10.8.4
Health care microgrid systems shall be recommissioned for operation when the system configuration changes or every five years, whichever occurs first.

What happened this summer while we were all social distancing???

NFPA Working Group Met VIRTUALLY

We correlated 99, 70, & 110.

We established Healthcare microgrid across codes.

NFPA 70 – 705…

Will include text allowing **microgrid on normal branch** for <u>every building</u>.

Public Input 2182-NFPA70-2020

New Article after 100

<u>Health Care Microgrid</u>

<u>A group of interconnected loads and distributed energy resources within clearly defined boundaries that acts as a single controllable entity with respect to the utility.</u>

Public Input NFPA-70-2020

517.30 Sources of Power.

(A) Two Independent Power Sources.

Essential electrical systems shall have a minimum of the following two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted. [**99:**6.7.1.2.2]

.B) Types of Alternate ~~Power~~ Sources.

(1) Generating Units.

Where the normal source consists of generating units on the premises, the alternate source shall be either another generating set or an external utility service. [**99:**6.7.1.2.3]

(2) Fuel Cell Systems…

(3) ~~Battery~~ Energy Storage Systems …

~~Battery~~ Energy Storage systems shall be permitted to serve as the alternate source for all or part of an essential electrical system.

Public Input 2173-NFPA-70-2020

517.30 New Section after 517.30(B) Sources of Power. (continued)

(4) **Health Care Microgrid.** A Health Care microgrid shall be permitted to serve as the alternate source for all or part of an essential electrical system.

Informational Note: The health care microgrid components shall meet the installation and maintenance requirements of the applicable NFPA code.

Informational Note: For information on health care microgrids, see NFPA 99-2-10 Health Care Facilities Code.

Public Input NFPA-70-2020

517.30 Sources of Power.

(A) Two Independent Power Sources.

Essential electrical systems shall have a minimum of the following two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternate sources for use when the normal source is interrupted. [**99:**6.7.1.2.2] Acceptable Alternate sources include:

~~.B) Types of Power Sources.~~

(1) Generating Units.

Where the normal source consists of generating units on the premises, the alternate source shall be either another generating set or an external utility service. [**99:**6.7.1.2.3]

(2) Fuel Cell Systems…

(3) ~~Battery~~ Energy Storage Systems …

~~Battery~~ Energy Storage systems shall be permitted to serve as the alternate source for all or part of an essential electrical system.

Public Input 2194-NFPA-70-2020 (alternate) (cont.)

517.30 Sources of Power. (continued)

~~(~~B) Health Care Microgrid.

Essential electrical systems shall be permitted to be supplied by a health care microgrid that also supplies non-essential loads. The health care microgrid is permitted to share distributed resources with the normal system. Healthcare microgrid systems shall be designed with sufficient reliability to provide effective facility operation consistent with the facility emergency operations plan. Healthcare microgrid system components shall not be compromised by failure of the normal source.

Informational Note: The health care microgrid is intended to take the place of, and include, both the normal source and the alternate source.

Informational Note: For information on health care microgrids, see NFPA 99-2-10 Health Facilities Code.

Informational Note: If this health care microgrid also serves normal loads, the equipment associated with the normal loads is not required to conform to requirements for essential system components.

“…sufficient reliability…”

- NFPA 110
- CMS
- Practice
- California???

MICROGRIDS $\approx$ ENERGY CODES

Prescriptive

Performance

NFPA 855 – Standard for the Installation of Stationary Energy Storage Systems

- New Standard
- **Chapter 11 -** requires fuel cells energy storage systems to be installed and maintained in accordance with NFPA 70, NFPA 853, manufacturer's instructions and the equipment listing.
- Sets standard for system interconnections, commissioning, operation and maintenance and decommissioning of energy storage systems.

MAZZETTI

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3. **Presentation: California Fire Code (CFC)—Energy Systems**

Facilitator: Nanci Timmins, OSHPD (or designee)

- A brief introduction to CFC and Energy Systems
- Discussion and public input

HBSB Technology Committee September 2020

Nanci Timmins
Chief Fire and Life Safety Officer

CFC CHAPTER 12

Electrical Energy Systems

Energy Systems

Energy Systems

- A new Chapter 12, Energy Systems is added to the Fire Code. Chapter 12 addresses all configurations of energy systems. The chapter contains the emergency power, standby power, and stationary battery storage system requirements previously located in Chapter 6 of the Fire Code. In addition, Chapter 12 also includes new requirements for other methods of energy generation and storage.

1203 EMERGENCY AND STANDBY POWER SYSTEMS

1204 SOLAR PHOTOVOLTAIC POWER SYSTEMS

1205 STATIONARY FUEL CELL POWER SYSTEMS

1206 ELECTRICAL ENERGY STORAGE SYSTEMS

Energy Systems

- **1203 EMERGENCY AND STANDBY POWER SYSTEMS**
- The requirements in the Fire Code regulating emergency and standby power are relocated from Section 604 to Section 1203 with few revisions.
- Extensive provisions regulating the construction and installation of emergency and standby power systems for Group I-2 occupancies are found in:
- California Electrical Code (NFPA 70)
- NFPA 99 Health Care Facilities Code
- NFPA 37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
- NFPA 110 Standard for Emergency and Standby Power Systems

Energy Systems

- **1204 SOLAR PHOTOVOLTAIC POWER SYSTEMS**
- The requirements in the Fire Code regulating solar photovoltaic power systems are relocated from Section 605.11 to Section 1204.
- The California State Fire Marshal extensively amended the solar photovoltaic power system requirements contained in the Fire Code. The State Fire Marshal no longer amends the requirements regulating solar photovoltaic power systems.
- The 2018 International Fire Code incorporates the California State Fire Marshal’s 2016 mid-cycle amendments to the solar photovoltaic power system requirements contained in the Fire Code.
- While the model code language is extensively revised, the new model code language is consistent with the CFC amendments published in the 2017 CFC Supplement.

Energy Systems

- **1205 STATIONARY FUEL CELL POWER SYSTEMS**
- Chapter 12 includes new provisions for fuel cell power systems. Fuel cell power systems are often used to meet a facility’s energy needs. Stationary fuel cell power systems generate power through an electrochemical process that combines hydrogen and oxygen to produce electricity. The hydrogen comes from a direct hydrogen source or from any hydrocarbon fuel such as natural gas, gasoline, diesel, or methanol if the fuel cell power system includes integral reforming.
- Section 1205 provides a comprehensive set of requirements to mitigate potential hazards associated with the installation and use of stationary fuel cell power systems.

Energy Systems

- **1205 STATIONARY FUEL CELL POWER SYSTEMS**
- Stationary fuel cell systems include two types of listed systems and field fabricated systems:

1. *Prepackaged fuel cell power systems* shall be listed and labeled in accordance with CSA FC 1.
2. A *pre-engineered fuel cell power system* with modules and components listed and labeled in accordance with CSA FC 1 and interconnected to complete the assembly of the system at the job site.
3. *Field-fabricated fuel cell power systems* approved based on a review of the technical report provided in accordance with Section 104.7.2.

ANSI/CSA FC 1-2014 - Fuel cell technologies - Part 3-100: Stationary fuel cell power systems - Safety

Energy Systems

- **SECTION 1206 ELECTRICAL ENERGY STORAGE SYSTEMS**
- Revisions to the Fire Code move the stationary battery storage system requirements from Section 608 to Section 1206.2 and include new battery technologies and required safety features. The California State Fire Marshal no longer amends the Fire Code provisions regulating stationary battery storage systems.
- Section 1206.3 establishes basic protection requirements for capacitor energy storage systems (CESS). These provisions are new to the Fire Code and include safety measures that are similar to battery storage system requirements.
- **1206.1 Scope.** The provisions in this section are applicable to energy storage systems designed to provide electrical power to a building or facility. These systems are used to provide standby or emergency power, an uninterruptable power supply, load shedding, load sharing or similar capabilities.

Energy Systems

- **Stationary storage battery systems.**
- Several new battery types are now regulated. Battery types include flow batteries, lead-acid, lithium, nickel cadmium, sodium-beta batteries, and a category for other technologies. As the technology for batteries and energy storage continues to evolve, a category for other battery technologies will allow for future development and application of such technologies.

Energy Systems

- **Stationary storage battery systems.**
- A new Table 1206.2 is included which changes the method for determining when a battery system must comply with the requirements contained in Section 1206.2. Previously, the threshold was based on the quantity in gallons of electrolyte or the weight in pounds of lithium-ion and lithium metal polymer batteries. The threshold is now based on the electrical output of the system. The regulation threshold of lead-acid and nickel cadmium (Ni-Cd) systems is at 70 kWh and lithium, sodium and flow battery systems at 20 kWh. All other technologies are regulated when they exceed 10 kWh.

TABLE 1206.2
BATTERY STORAGE SYSTEM THRESHOLD QUANTITIES.

BATTERY TECHNOLOGY	CAPACITY[a]
Flow batteries[b]	20 kWh
Lead acid, all types	70 kWh
Lithium, all types	20 kWh
Nickel cadmium (Ni-Cd)	70 kWh
Sodium, all types	20 kWh[c]
Other battery technologies	10 kWh

For SI:1 kilowatt hour = 3.6 megajoules.
a. For batteries rated in amp-hours, kWh shall equal rated voltage times amp-hour rating divided by 1000.
b. Shall include vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.
c. 70 kWh for sodium-ion technologies.

Energy Systems

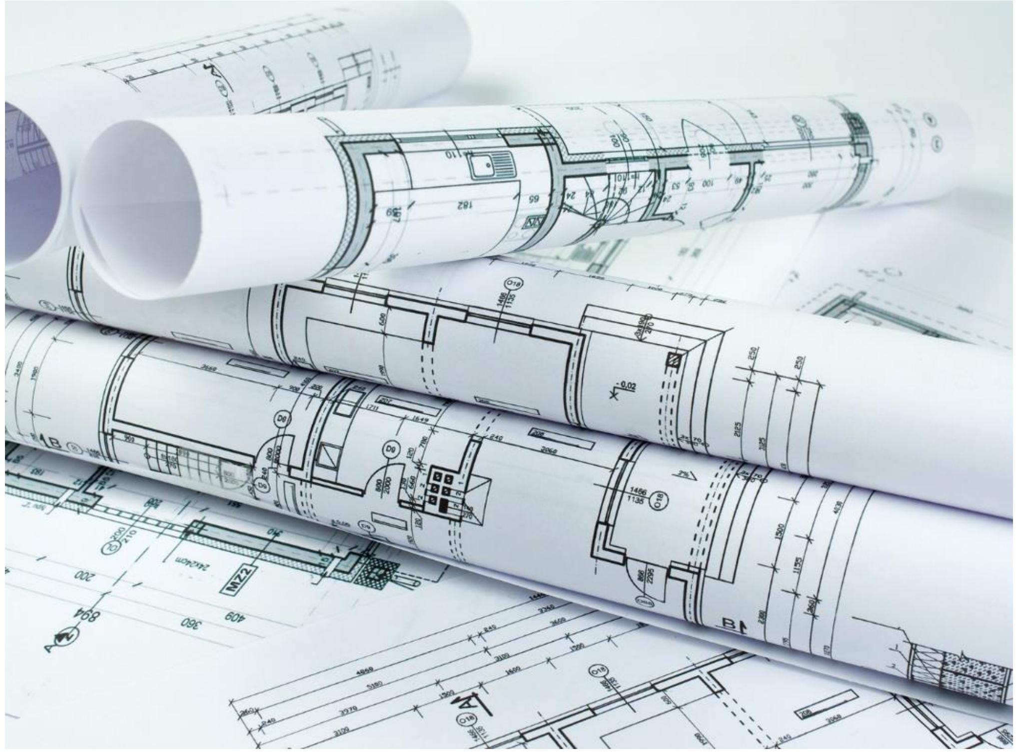
- **Stationary storage battery systems.**

Energy Systems

- **Stationary storage battery systems.**
- When the thresholds identified in Table 1206.2 are exceeded, the following provisions shall apply.
- <u>**1206.2.1 Permits.** Permits shall be obtained for the installation and operation of stationary storage battery systems in accordance with Section 105.7.2.</u>

Energy Systems

- **Stationary storage battery systems.**
- Requirements now include information to be provided on construction documents submitted with the permit application.



Energy Systems

Stationary storage battery systems.

1206.2.2 Construction documents. The following information shall be provided with the permit application:

- 1. Location and layout diagram of the room in which the stationary storage battery system is to be installed.
- 2. Details on hourly fire-resistance-rated assemblies provided.
- 3. Quantities and types of storage batteries and battery systems.
- 4. Manufacturer's specifications, ratings and listings of storage batteries and battery systems.
- 5. Details on energy management systems.
- 6. Location and content of signage.
- 7. Details on fire-extinguishing, smoke detection and ventilation systems.
- 8. Rack storage arrangement, including seismic support criteria.

Energy Systems

- **Stationary storage battery systems.**
- A hazardous mitigation report containing an analysis evaluating failure modes and effects is required when:
  - The battery system falls into the “other battery technology” category, or
  - When multiple types of battery systems are located within a room or area, or
  - When the applicant desires to increase the quantities above those allowed in Section 1206.2.9.

Energy Systems

Stationary storage battery systems.

1206.2.3 Hazard mitigation analysis. A failure modes and effects analysis (FMEA) or other approved hazard mitigation analysis shall be provided in accordance with Section 104.7.2 under any of the following conditions:

- 1. Battery technologies not specifically identified in Table 1206.2 are provided.
- 2. More than one stationary storage battery technology is provided in a room or indoor area where there is a potential for adverse interaction between technologies.
- 3. When allowed as a basis for increasing maximum allowable quantities in accordance with Section 1206.2.9.

Energy Systems

- **Stationary storage battery systems.**
- What is a failure mode?

Energy Systems

- **Stationary storage battery systems.**
- The Fire Code specifies the location and construction of rooms and areas where stationary storage battery systems are permitted.

Energy Systems

- **Stationary storage battery systems.**
- The Fire Code references the Building Code for separation requirements.
- **1206.2.8.2 Separation.** Rooms containing stationary storage battery systems shall be separated from other areas of the building in accordance with Section 509.1 of the *California Building Code*. Battery systems shall be allowed to be in the same room with the equipment they support.

Room or Area	Separation and/or Protection
Stationary storage battery systems having ~~a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer~~ an energy capacity greater than the threshold quantity specified in Table 1206.2 of the *International Fire Code*	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies
Electrical installations and transformers	See Sections 110.26 through 110.34 and Sections 450.8 through 450.48 of NFPA 70 for protection and separation requirements

(No changes to other portions of Table 509.)

Energy Systems

- **Stationary storage battery systems.**
- The Fire Code includes requirements for the arrangement of battery arrays located in rooms or areas.
- What is a battery array you might ask?
- **STATIONARY BATTERY ARRAY.** An arrangement of individual stationary storage batteries in close proximity to each other, mounted on storage racks or in modules, battery cabinets or other enclosures.

Energy Systems

- **Stationary storage battery systems.**
- **1206.2.8.3 Stationary battery arrays.** Storage batteries, prepackaged stationary storage battery systems and pre-engineered stationary storage battery systems shall be segregated into stationary battery arrays not exceeding 50 kWh (180 megajoules) each. Each stationary battery array shall be spaced not less than 3 feet (914 mm) from other stationary battery arrays and from walls in the storage room or area. The storage arrangements shall comply with Chapter 10.

Exceptions:

1. Lead acid and nickel cadmium storage battery arrays.

2. Listed pre-engineered stationary storage battery systems and prepackaged stationary storage battery systems shall not exceed 250 kWh (900 megajoules) each.

Energy Systems

- **Stationary storage battery systems.**
- **1206.2.8.3 Stationary battery arrays.**

Exceptions:

3. The fire code official is authorized to approve listed, pre-engineered and prepackaged battery arrays with larger capacities or smaller battery array spacing if large-scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving one array will not propagate to an adjacent array, and be contained within the room for a duration equal to the fire resistance rating of the room separation specified in Table 509 of the *California Building Code.*

Energy Systems

- **Stationary storage battery systems.**
- ***H Occupancy? Maybe.***
- A new section to the Fire Code provides a limit on the size of a battery system that can be installed without classification as a Group H occupancy. Table 1206.2.9 establishes the maximum size. The allowable size is based on electrical output with no limit for lead acid and nickel cadmium (Ni-Cd) systems. Lithium, sodium or flow battery systems that exceed 600 kWh must be placed into a Group H-2 occupancy. All other technologies are to be located in a Group H-2 when they exceed 200 kWh.

TABLE 1206.2.9
MAXIMUM ALLOWABLE BATTERY QUANTITIES

BATTERY TECHNOLOGY	MAXIMUM ALLOWABLE QUANTITIES[a]	GROUP H OCCUPANCY
Flow batteries[b]	600 kWh	Group H-2
Lead acid, all types	Unlimited	Not Applicable
Lithium, all types	600 kWh	Group H-2
Nickel cadmium (Ni-Cd)	Unlimited	Not Applicable
Sodium, all types	600 kWh	Group H-2
Other battery technologies	200 kWh	Group H-2[c]

For SI:1 kilowatt hour = 3.6 megajoules.

a. For batteries rated in amp-hours, Kilowatt-hours (kWh) shall equal rated battery voltage times the amp-hour rating divided by 1,000.

b. Shall include vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

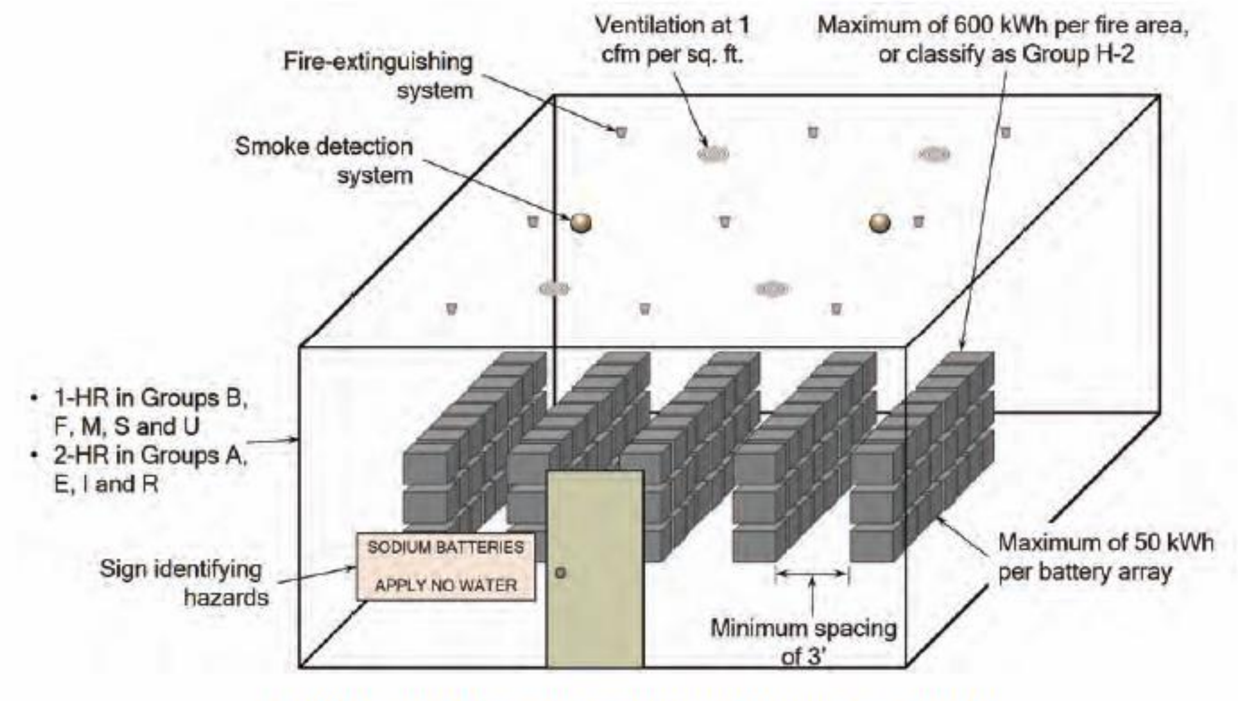
c. Shall be a Group H-4 occupancy if the fire code official determines that a fire or thermal runaway involving the battery technology does not represent a significant fire hazard.

Energy Systems

- **Stationary storage battery systems.**

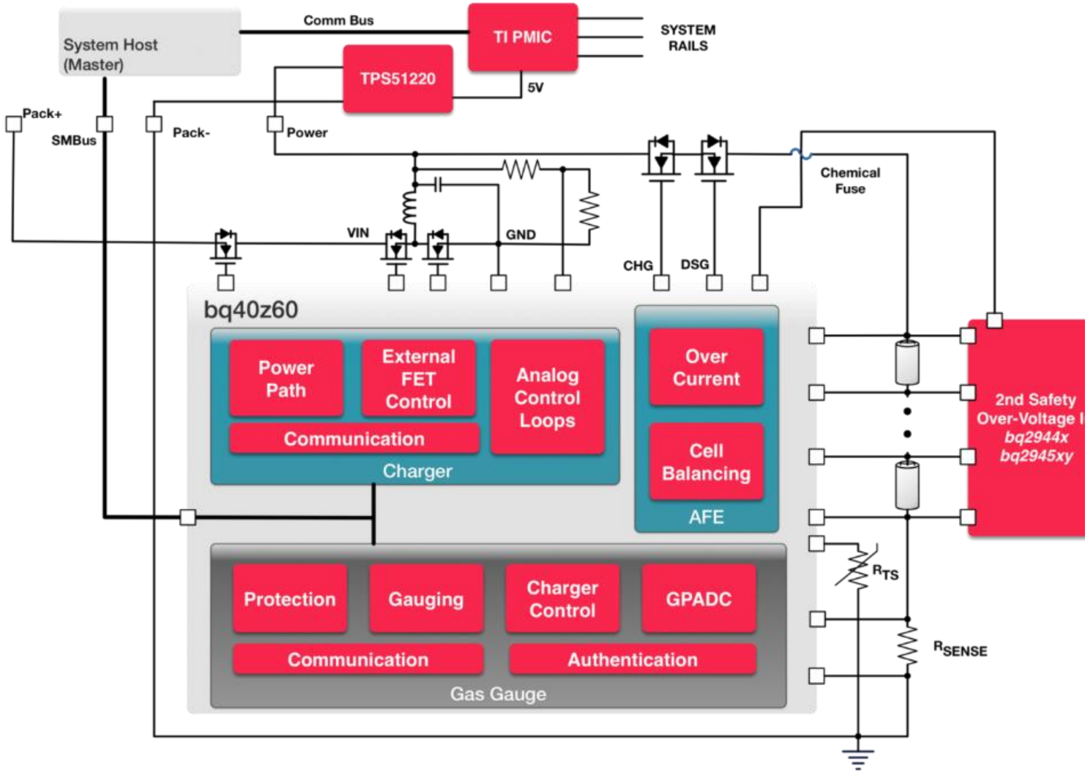
Energy Systems

Sodium beta battery system example



Stationary Storage Battery System Example

Energy Systems



- **Stationary storage battery systems.**
- Battery systems, other than lead-acid and Ni-Cd, must be provided with an energy management system. This system monitors the voltage, current and temperatures of each battery. When hazardous temperatures or conditions are detected, it sends an alarm to an approved location.

Energy Systems

- **Stationary storage battery systems.**
- Section 1206.2.11.1 requires an automatic sprinkler system in rooms containing a stationary storage battery system. However, Section 1206.2.11.1.1 allows the use of alternate fire-extinguishing systems for protecting batteries that present a water reactive hazard.
- As with other provisions of Section 1206.2, automatic sprinkler system and alternate fire-extinguishing system requirements are only applicable when the threshold levels of Table 1206.2 are exceeded, however; when located in a Group I-2 hospital, automatic sprinkler system protection is required. Substitution of automatic sprinkler system protection with an alternate fire-extinguishing system is not permitted in a Group I-2 hospital.

Energy Systems

- **Stationary storage battery systems.**
- Section 1206.2 is a complete revision of the stationary battery storage system requirements previously located in Section 608.
- Requirements related to spill control, neutralization, ventilation, signage, seismic protection and smoke detection are significantly revised.
- Section 1206.2 includes a number of new subjects not addressed in the previous code including, vehicle impact protection, electrical disconnects, outdoor installations, gas detection systems and specific requirements for different battery types.
- Not all of the revisions are included in this introduction.

Energy Systems

- **SECTION 1206 ELECTRICAL ENERGY STORAGE SYSTEMS**
- Section 1206.3 establishes basic protection requirements for capacitor energy storage systems (CESS). These provisions are new to the Fire Code and include safety measures that are similar to battery storage system requirements.

Energy Systems

- Smaller capacitor storage systems and capacitors regulated by the California Electrical Code are not regulated by the Fire Code.

- **1206.3 Capacitor energy storage systems.** Capacitor energy storage systems having capacities exceeding 3 kWh (10.8 megajoules) shall comply with Sections 1206.3 through 1206.3.2.6.1.
- **Exception:** Capacitors regulated by NFPA 70, Chapter 460, and capacitors included as a component part of other listed electrical equipment are not required to comply with this section.

Energy Systems

- **Capacitor energy storage systems.**
- The requirements for battery energy storage systems and capacitor energy storage systems are similar.

Battery or Capacitor?

Energy Systems

- **Capacitor energy storage systems.**
- When capacitor energy storage systems are regulated by the Fire Code, requirements for permits, location, construction, separation, electrical disconnects, outdoor installations, fire extinguishing and detection systems, ventilation, spill control and neutralization are similar to the requirements for battery energy storage systems.

Energy Systems

- **Capacitor energy storage systems.**
- The requirements for separation of capacitor energy storage systems are not located in Section 509.1 the Building Code. These requirements are located in the Fire Code.
- **1206.3.2.2 Separation.** Rooms containing capacitor energy storage systems shall be separated from the following occupancies by fire barriers or horizontal assemblies, or both, constructed in accordance with the *International Building Code*.

    1. Group B, F, M, S and U occupancies by 1-hour fire-resistance-rated construction.

    2. Group A, E, I and R occupancies by 2-hour fire resistance-rated construction.

Energy Systems

- **Capacitor energy storage systems.**

- **1206.3.3 Maximum allowable quantities.** Fire areas within buildings containing *capacitor energy storage systems* that exceed 600 kWh of energy capacity shall comply with all applicable Group H occupancy requirements in this code and the *California Building Code*.

Energy Systems

- **Capacitor energy storage systems.**
- If there is a product, there is a standard.
- **1206.3.4.1 Listing.** Capacitors and *capacitor energy storage systems* shall comply with the following:

    1. Capacitors shall be listed in accordance with UL 1973.

    2. Prepackaged and pre-engineered stationary capacitor energy storage systems shall be listed in accordance with UL 9540.

    UL 1973 Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications

    UL 9540 Standard for Energy Storage Systems and Equipment

Thank you!

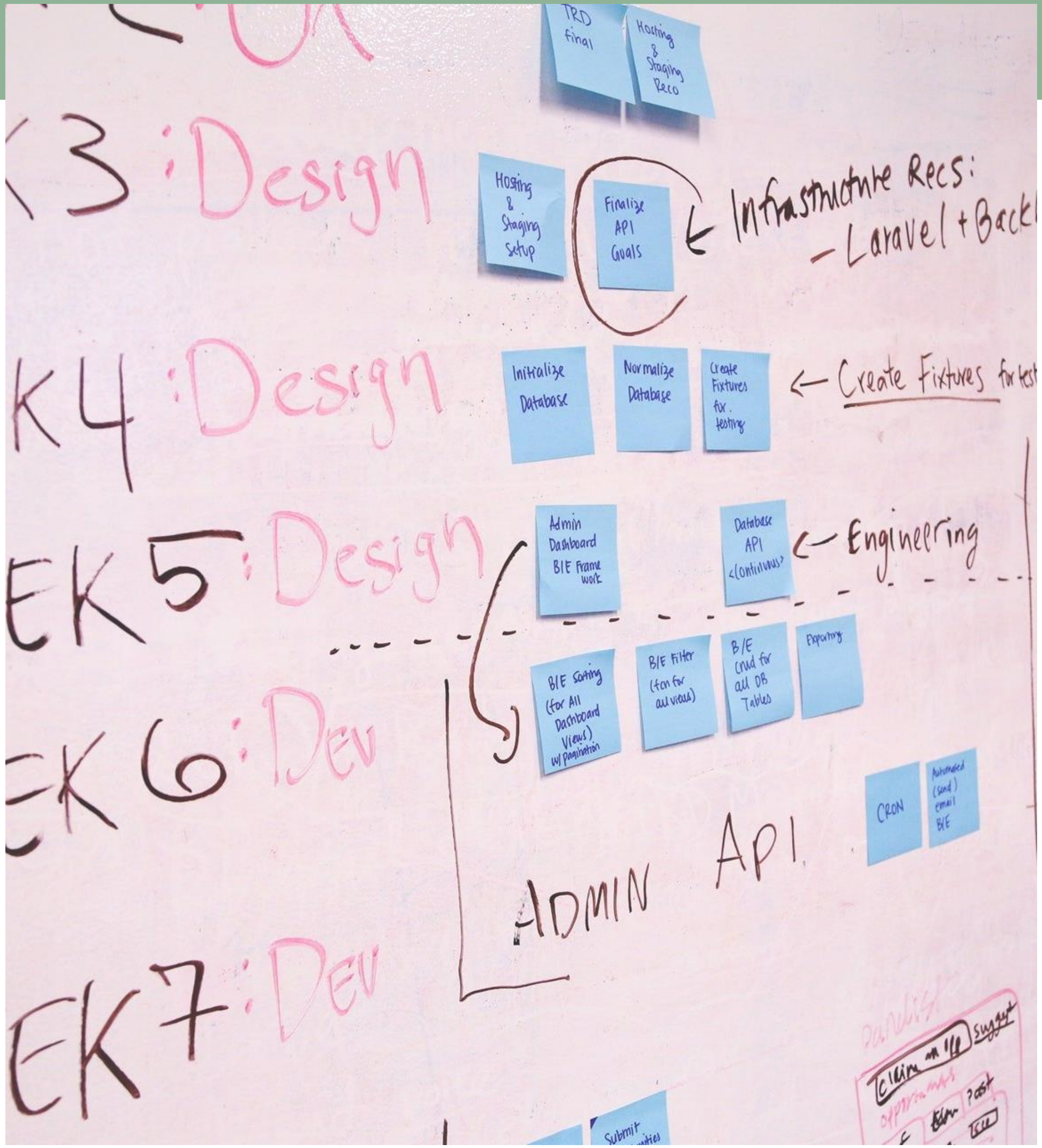
4. **Presentation: The Digital Hospital; Value-based Integration between Clinical, Information, and Building Systems**

   Facilitator: Bruce Rainey, Committee Vice-Chair; Phil Crompton, Vantage Technology Consulting Group (or designee)

   - The next generation of digital hospitals will engage patients and their families, improve staff workflows, and enhance the healing environment. Instead of siloed, proprietary, and costly systems, these new hospitals will feature integrated clinical, information, and building systems that work together to automate low-value tasks, improve efficiency, reduce errors, and advance healing. This presentation will use a case study project to address the common mistakes made when planning a new healthcare facility and provide attendees with a roadmap for designing a digital hospital.
   - Discussion and public input

OSHPD Hospital Building Safety Board

The Digital Hospital; Value-based Integration between Clinical, Information, and Building Systems



Agenda

- What is a Digital Hospital?
- Opportunities and Challenges
- Roadmap and Recommendations
- Feedback and Discussion

Patient and Family Member Engagement

- I want to control my surroundings
  - Temperature, lights, blinds, and other settings
  - Order meals when I want
  - Have someone come and clean up, or fix something
- I want to know who is in my Care Team, and who just walked into my room
- I want to see my daily schedule
- I want to watch my discharge and other treatment videos
- I want to do these things from my own device (BYOD)
- I want to use my device as if I was at home to
  - See my Facebook, Instagram, and LinkedIn pages
  - Use Facetime, Skype, or Zoom to see my family
  - Watch my Netflix/Amazon Prime/Hulu shows
  - Play my games
- I don't want to be bothered with all these technologies!

Image from LG Healthcare

Clinician Experience

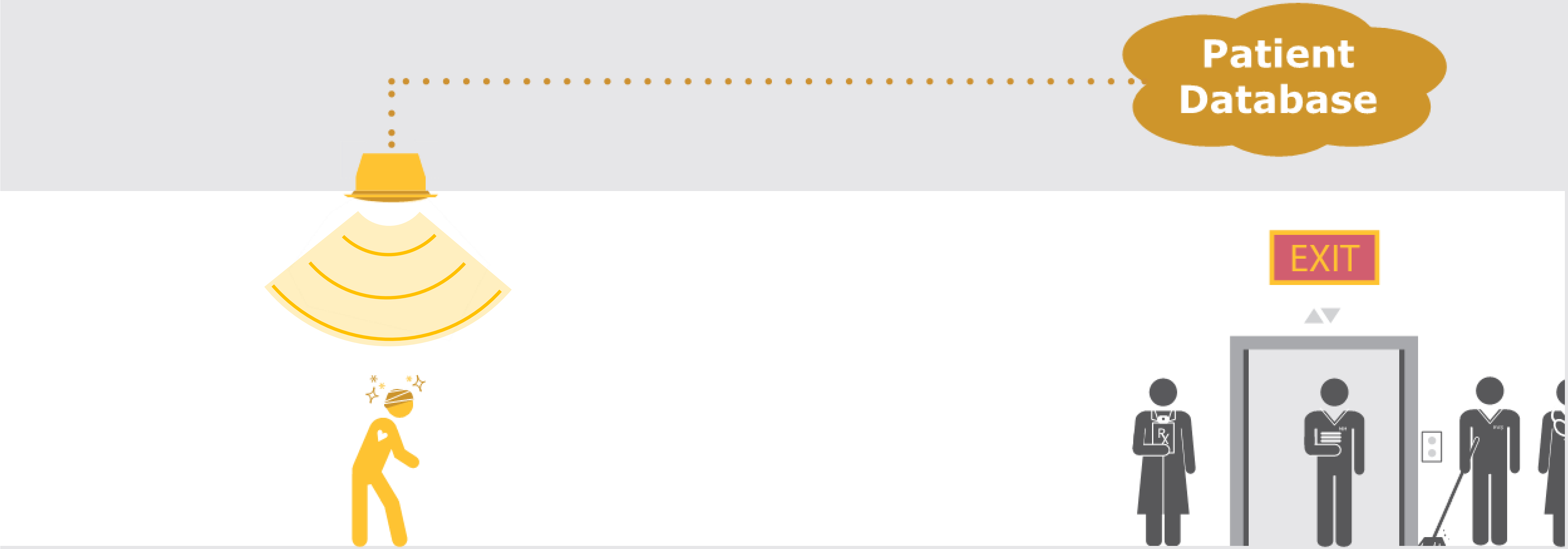
- I want to have more time to focus on my patients and other ‘high-value’ tasks by automating ‘low-value’ tasks
- I want the Hospital’s systems to provide me with the information I need, when I need it, wherever I am in the building (or elsewhere)
- I want the Hospital to tell me where staff, patients, and equipment are so I can stop ‘hunting and gathering’ all the time
- I want the Hospital to help protect and care for my patients
- I want my patients to be able to manage their environment and feel empowered and engaged
- I want to feel safe and secure, and know that help will come when I need it.
- I want the Hospital to manage our par levels so we don’t run out of medications, PPE supplies, and other consumables

A Digital Hospital…

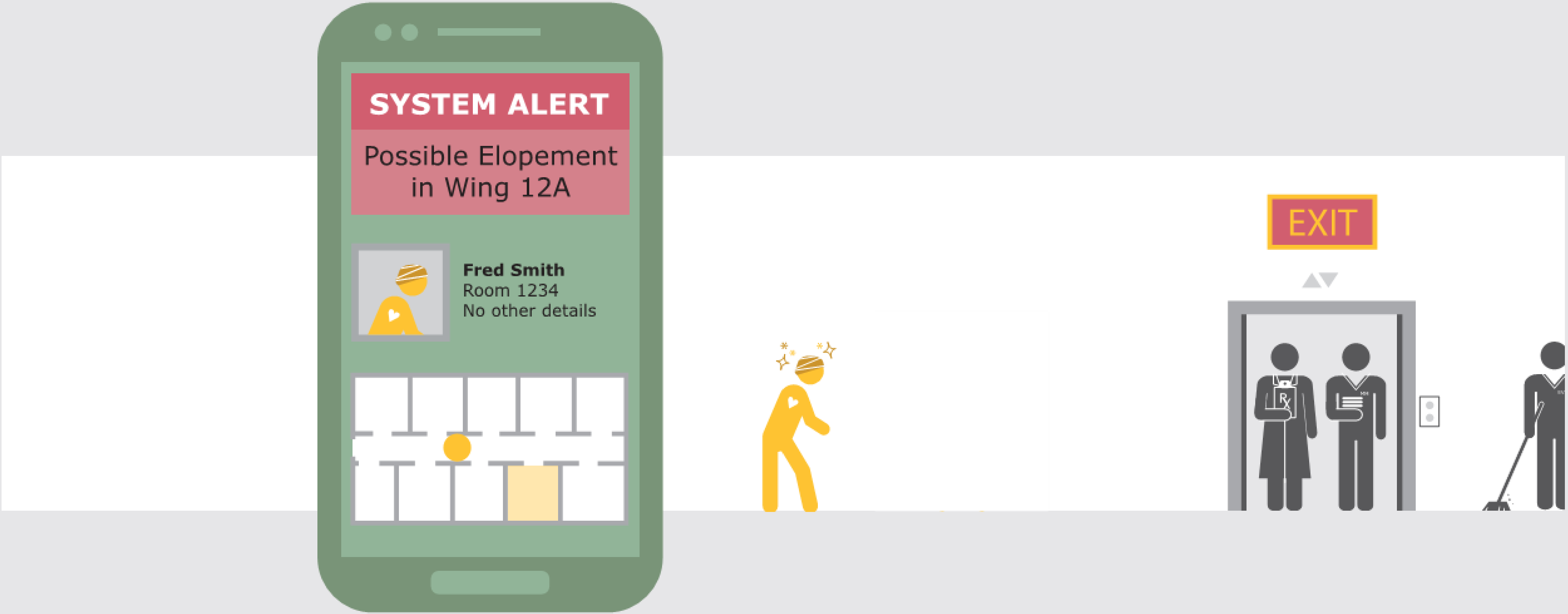
- Utilizes technology to engage patients and their families, improve staff workflows, and enhance the healing environment
- Integrates clinical, information, and building (including IoT) technologies to work together to automate 'low-value' tasks, improve efficiency, reduce errors, and advance healing
- Prioritizes safety and security of patients, family members, and staff and helps address regulatory requirements
- Incorporates AI and Big Data technologies to support precision medicine
- Includes provisions for future technologies as the healthcare environment continues to evolve

BUILDING AS CAREGIVER

BUILDING AS CAREGIVER



BUILDING AS CAREGIVER



BUILDING AS CAREGIVER

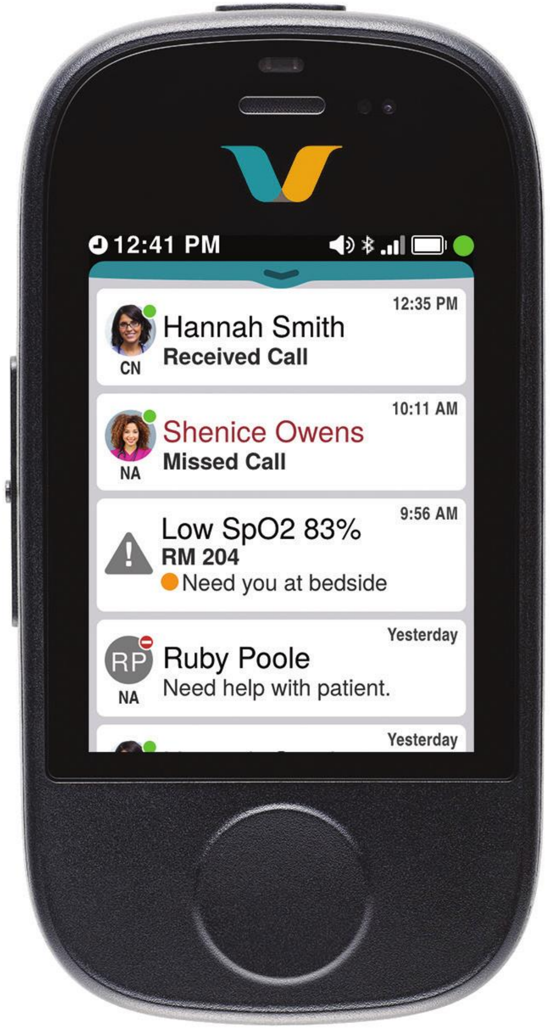


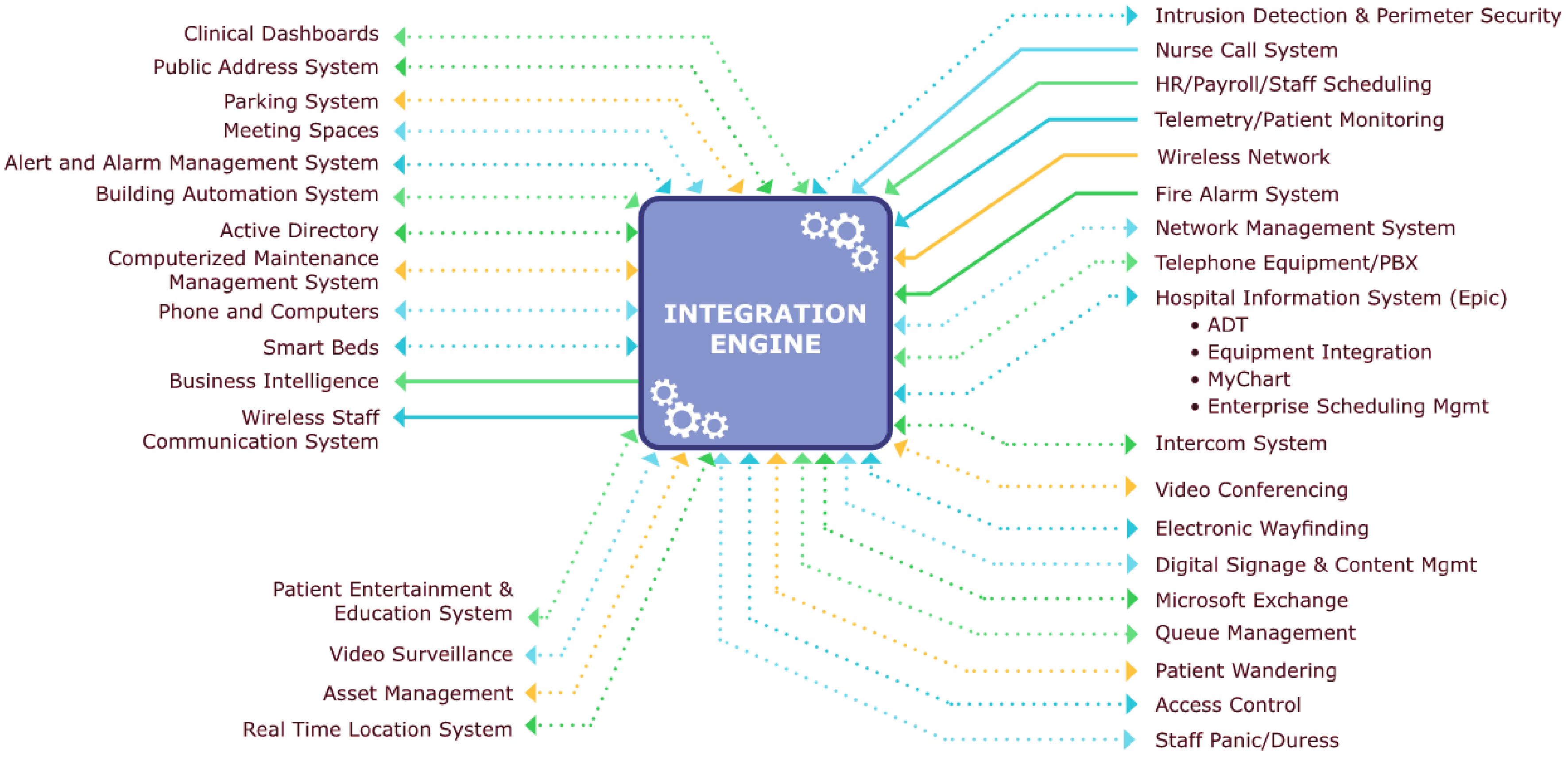
Image Vocera Smartbadge

Levels of Integration

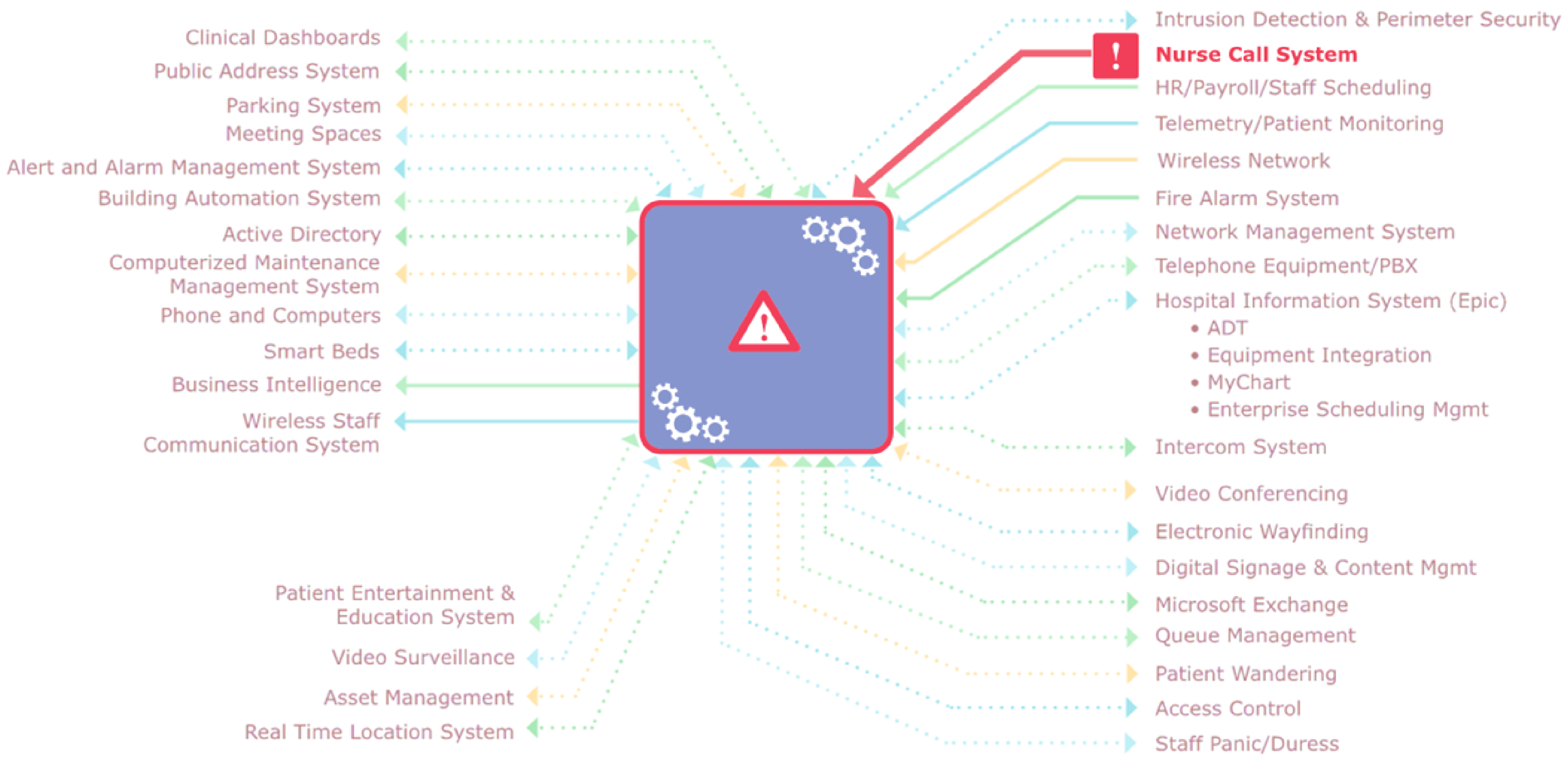
- Physical, hard-wired integration
  - Dry-contact closure
  - Simple communication

- Shrink-wrap integration
  - Built-in integration between systems

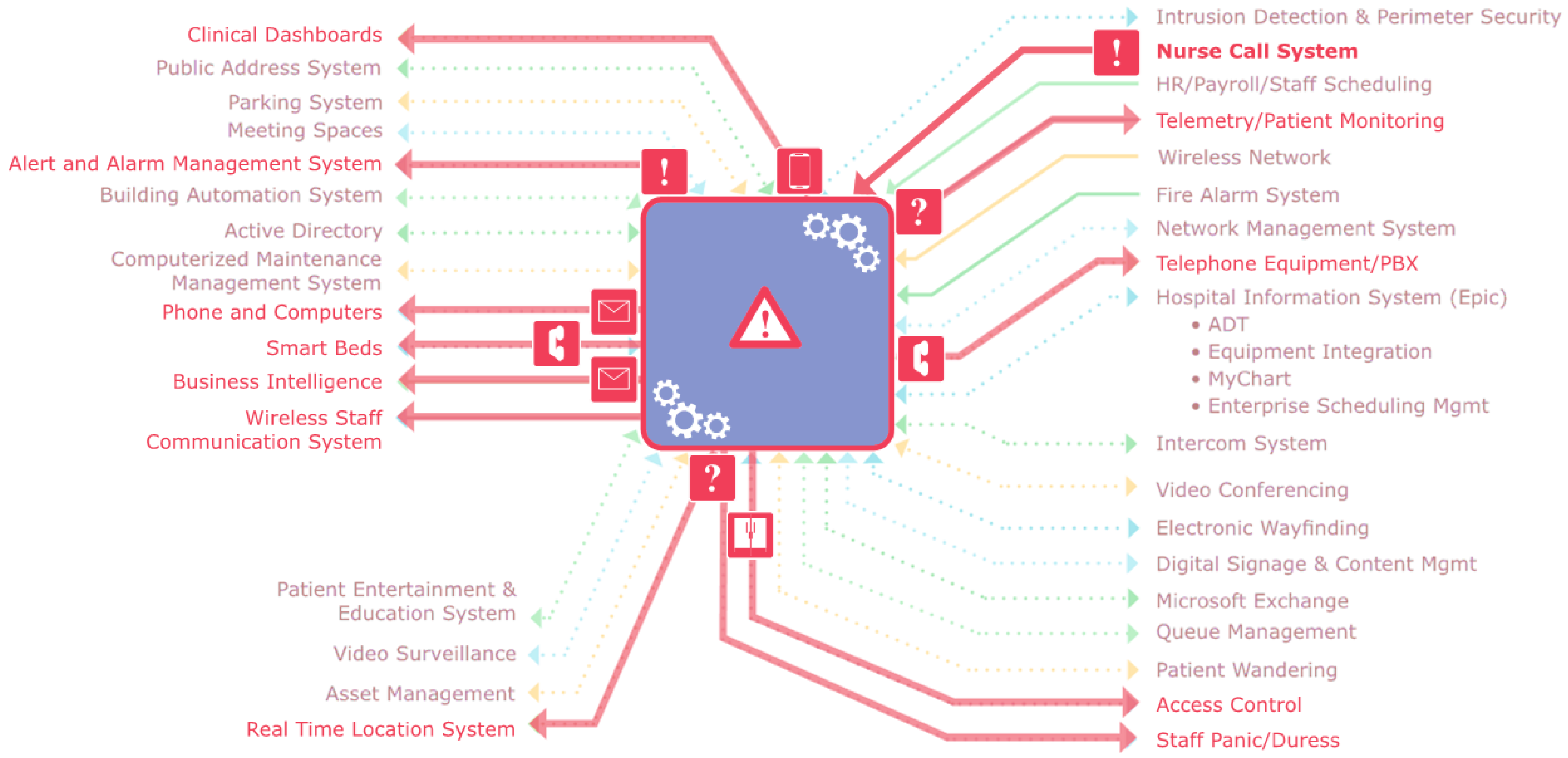
- Integration Engine (aka Enterprise Service Bus)
  - More complex integration that requires translation or other data manipulation



SYSTEMS INTEGRATION



SYSTEMS INTEGRATION



SYSTEMS INTEGRATION

Hospital Operational Command Center

Image GE Healthcare Partners

- Consolidates decision makers to one location
- Arms decision makers with real time meaningful information and dashboards
- Reinforces communication tools and processes from the decision makers to their teams
- Can be located in the Hospital or remotely

The Digital Hospital

DATA HARVESTING & INFORMATION SOURCES

'INTERNET OF THINGS' DATA GATHERING SENSORS & DEVICES

Wireless Access Points Real-time Location Sensors

Building Automation Systems, including Lighting Controls Occupancy Sensors Thermostats

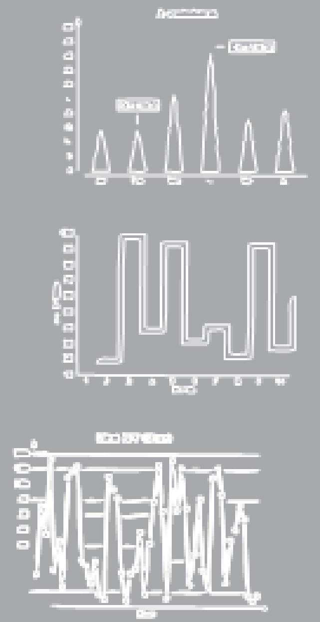
Security Cameras Access Card Readers Door Position Switches

ERP & Administrative Systems

Building and IoT Technologies

Archives & Other Information Sources

BIG DATA ANALYTICS



PASSIVE & INTERACTIVE OUTCOMES

Performance Monitoring, Trending & Reporting

Real-time Response & Actions

Predictive Analytics, Modeling & Simulation

PHOTO OF CONNEXIENT'S MEDINAV SMART PHONE APPLICATION

Opportunities

- Patient environment control
- Electronic wayfinding and navigation
- Workflow and clinical process automation
- Location-based integration with building systems
- Intelligent work-order creation and management
- Pandemic-related features
  - Contact tracing
  - Automated body temperature reading
  - Social distancing alarms

Common Mistakes

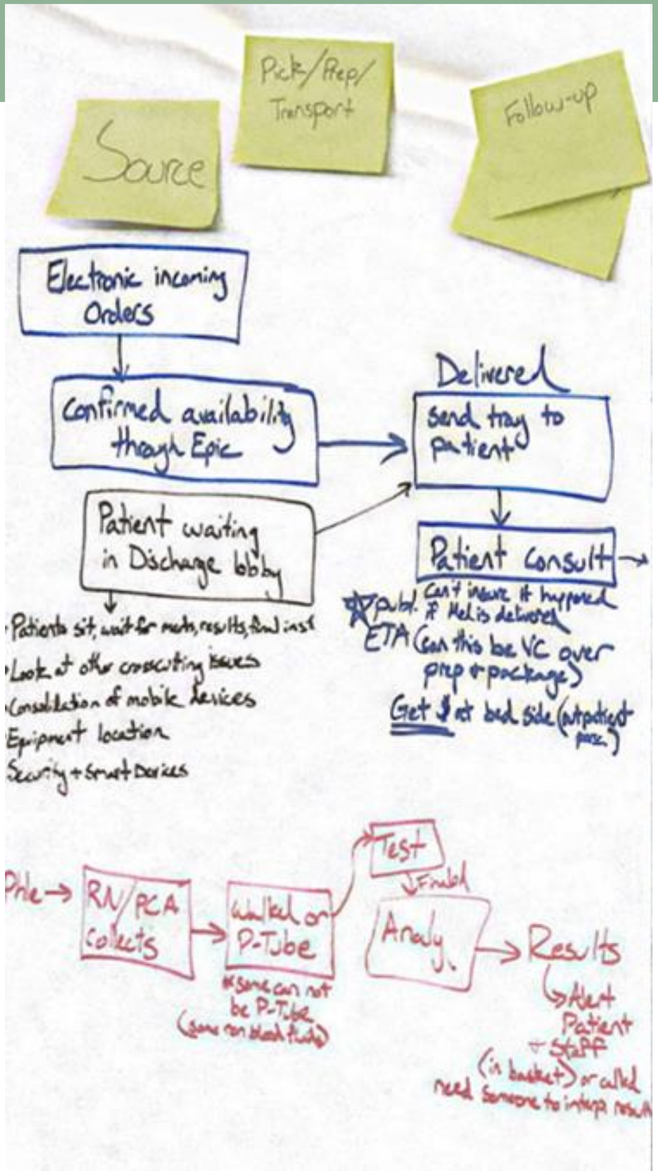
- Systems are thought about as stand-alone silos rather than integrated solutions
- System selections are based upon existing standards without challenging the status-quo
- Patient experience provides minimal control of the room by the patient and patent's family
- Staff workflows and processes are not considered during system design
- Systems are not ubiquitous throughout the Hospital
- Systems are not always 'open' and are often proprietary

Building systems and technologies should…

- Be based on open architecture, not proprietary systems
- Move to standardized interfaces and power (PoE) and away from hard-wired systems
- Look for opportunities to reduce number of systems by having systems perform multiple functions
- Add value to the patient, family member and the Owner
- Be procured at the Last Responsible Moment
- Have multiple service vendors in region, and allow service vendors to buy parts and smarts from manufacturer

Risks and Challenges

- What if something breaks?
- What if the network goes down?
- What if I'm overwhelmed with information?
- What if we're hacked?
- What if staff or patients can't or won't use the systems?



Set your project up for success

- System Responsibility Matrix
  "Who is responsible for what, including cost?"
- System Integration Matrix
  "Which systems should talk to other systems, and what is the purpose of each connection?"
- Last Responsible Moment Schedule
  "When should the team make decisions about the various systems?
- Common Network Rules of Engagement
  "What will I need to do to be allowed to run on the Hospital production network?"
- Obtain team consensus on the approach
  "The Owner, design team and contractors all need to be on the same page."

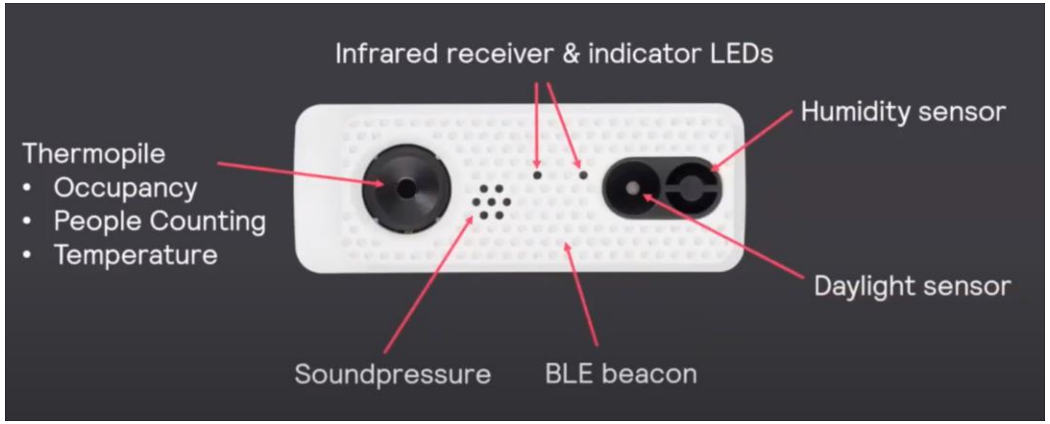
Think about the patient room

- BYOD & smart speakers to pillow speaker / sip & puff
- In-room camera for telemedicine, patient monitoring and video conferencing
- Patient and family member have environmental control
- Display supports both patient and clinical systems
- Digital Room signage integrated with clinical systems

Use the Hospital Production Network

- Building systems should ride on the Hospital's production network to take advantage of
  - Improved performance
  - Built-in resilience and fault-tolerance
  - Intrusion detection and firewalling
  - Continuous monitoring
- Duplicate or separate networks create confusion of ownership and responsibilities and introduce risk
- Ownership of the network and rules of engagement for the vendors whose systems run on it must be agreed ahead of time
- Remote access capabilities must be carefully managed

Plan for smart design

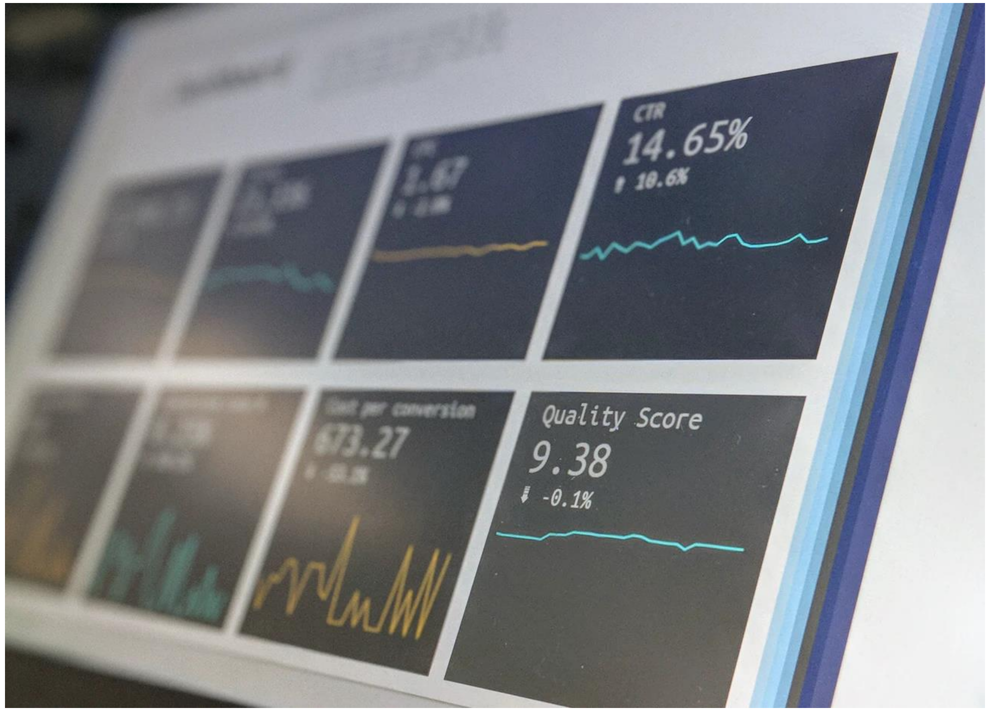


- Look for opportunities to reduce duplication of functions and features
- Establish a 'single source of truth' where possible
- Integrated, multi-function sensors reduce installation issues and cost
- Consider direction that technology is moving

  "Skate to where the puck will be. - Wayne Gretzky"

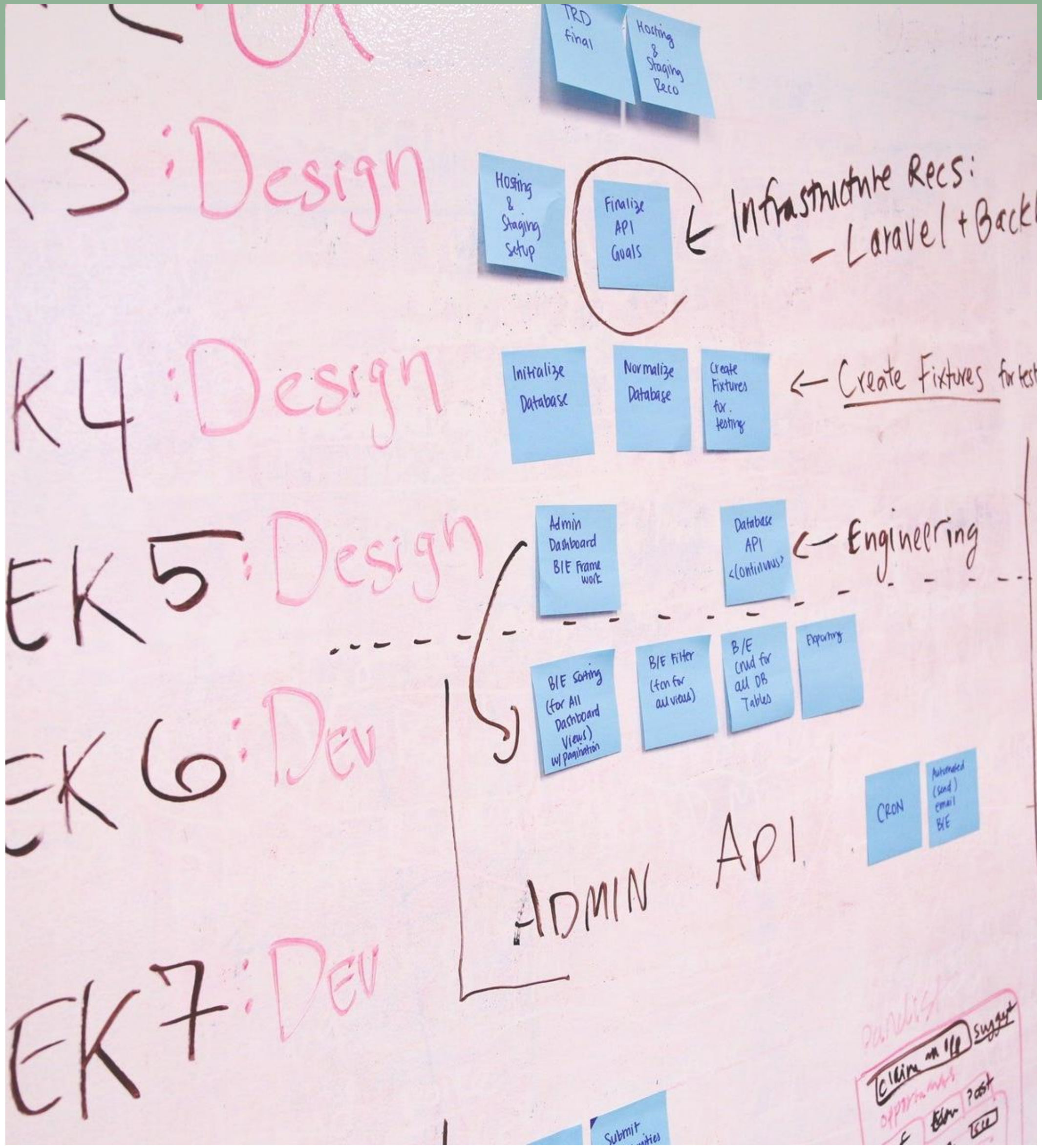
Include a Master Integrator

- Responsible for ensuring all integrated systems communicate properly; typically not a provider of one or more of those systems
- Collaborates with Owner to ensure systems information will be accessible and usable via dashboards and other formats
- Manages the software responsible for integration, aggregation, and communication of the building's technology and low voltage systems
- Provides on-going management and support for integrations once the Hospital is open and operating



Guard against information overload

- Access to more information isn't necessarily a good thing!
- Use integration engine, where appropriate, to provide cross-platform integrated data rather than individual programs for each system
- Agree on standardized naming conventions across the enterprise
- Create user-defined dashboards based on what's needed, not what's possible
- Include creation of custom dashboards in Master Integrator's scope



"Nervous is the new normal!"

- A new Hospital should be an opportunity
- The building technologies and systems should not be constrained by existing standards and practices where that does not make sense
- Systems should be designed to support Day One and future integration opportunities without sacrificing features, functions, or safety
- Understanding what impacts the building and/or its cost and what is 'building-agnostic' helps determine when decisions should be made
- Planning at an early stage allows the Owner to manage the cost of building technologies and systems

Feedback and discussion

5. Update: Technological Impacts and Considerations during COVID-19

Facilitator: Chris Tokas, OSHPD (or designee)

- How existing technologies have been used
- What has worked and what has not
- Areas of opportunity for future technology development
- Discussion and public input

Technological considerations during COVID-19 in Hospital Patient Care

How existing technologies in hospitals were used, what worked and didn't, and what future areas of opportunity for tech development need to be explored

Actions to Increase Space/Beds for Surge Capacity

- Normal operations, regular patient treatment, elective procedures paused through pandemic
- Increase No. of beds within the hospital proper
  - Use of shelled spaces
  - Increase patient room capacity
- Activation of decommissioned spaces in SPC-1 Buildings.
- Alternate Care Sites (FMS)

Making Patient Intake Safer (zero-contact intake process)

- Separate infectious patients
  - Patient Triage
  - Quarantine zones

Making Patient Intake Safer (zero-contact intake process)

EDs – Observations from the COVID 19 Experiment

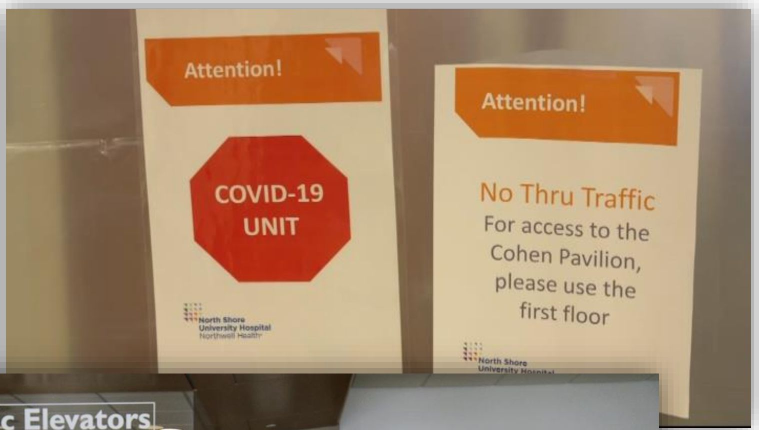
- Dedicated isolation and decontamination rooms that can be used for patients who present with infectious disease, behavioral-health or chemical-contamination issues
- Separate incoming and discharged patients
  - Multiple entrances for different levels of patient severity
- Reduces potential for cross contamination either in hallways, adjunct patient holding/waiting, or within radiology rooms
  - Interdepartmental imaging and X-ray facilities so patients don't have to be transported to the main hospital for tests

Making Patient Intake Safer (zero-contact intake process)

- Digital Check-in patients as they approach the hospital (GIS) Red, Yellow, Green designation based on symptoms
  - Higher-risk patients are escorted directly to care rooms
- Rethinking the medical record preadmittance component

The End of Traditional Single Entrance

- Implemented restrictions on patient/visitor traffic flow to control cross-contamination.
- Separate patients and clinicians from visitor traffic



Mobile Hospitals/Surge Tents

Alternate Care Sites

- Sports Arenas
- Large Exhibit Halls, etc.

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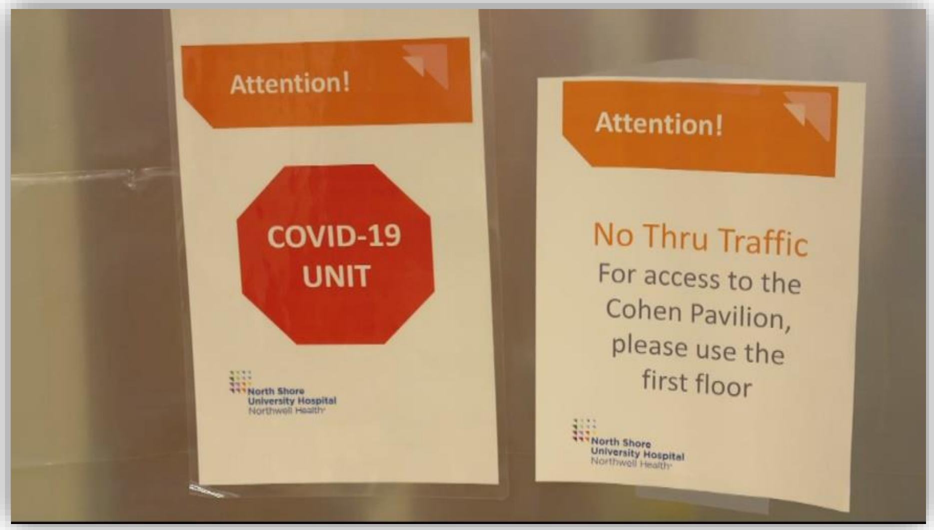
Portable Buildings Mobilized as Needed

- Increased adoption of prefabricated /modular elements for flexibility

Aggregating COVID-19 Into One Site or Hospital Wing



OSHPD
Office of Statewide Health
Planning and Development

Conversion of (E) Patient Units for Higher Acuity Patient Care

- More intensive care units / negative pressure isolation

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Conversion of (E) Patient Units for Higher Acuity Patient Care

- Negative pressure isolation anterooms

Building Management Systems Automation for Changing Patient Units for Higher Acuity Use

- Increase the number of airborne infection isolation rooms
- Some patient rooms adjustable to:
  - Negative pressure
  - All air exhausted through HEPA
- Some ORs with a negative ante-room
  - Operating rooms capable of switching from positive to negative
- Built-in options to converting patient rooms to negative pressure (similar to PIN 4)
- Possible further evaluation of circulation in triage/ED units

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HVAC System/Ventilation

- UV-C treatment at coils and/or filters
- R.H. from 40% to 60% in some spaces
- Enhanced filtration with MERV 13 or 14 as a starting point. 13 is more applicable to many spaces while 14 may induce excess pressure drop
- Measures to increase outdoor air rates (dilution)
- In-room HEPA recirculating systems
- Evaluate the application of minimum 6 total ACH where there starts to be a point of diminishing return in the reduction of Quanta within a room

HVAC System/Ventilation

- Adjustment to some negative HEPA/exhaust ICU spaces
- Increased locations for low return/exhaust grilles
- Dedicated exhaust path for each toilet stall (partitions up to the ceiling). Possible increase to 15 ACH

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MEDICAL GAS SYSTEM

- Availability of Ventilators
- Increase medical gases suction and electrical power capability, which can be deployed quickly to handle space needs in a massive patient surge
- Revisit Diversity Factors - Oxygen, Medical Air
- Piping Sizing Impact
- Medical gases and emergency power in non-patient areas that could be used for surge
- Systems Capacity

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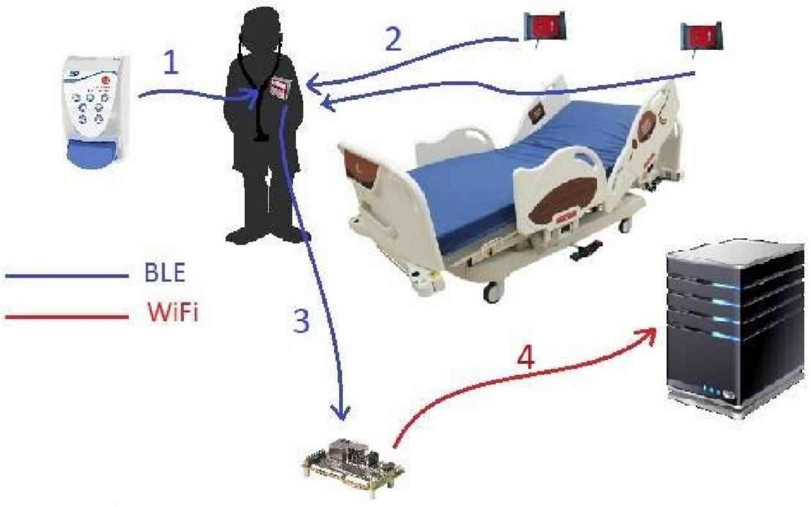
RFID Asset Tracking Software for Equipment, Patients and Staff

- A Radio Frequency Identification (RFID) system, allows staff to know the exact location and condition of critical resources needed.
- Track assets not only by room or bay, but even by shelf-level locators.
- **Expanding on this technology and tracking staff and patients can be a crucial aspect of defending the spread of infectious diseases in hospitals.**
- **The ability to know who and what the staff came in contact with can reduce the risk prior to it getting out of control.**

Automatic Infection Control Systems

- Handwashing Monitoring Systems
- Touchless operational components:
  - Water fountains
  - Water bottle fillers
  - Revolving doors
  - Elevators
  - Doors not requiring hand contact (accessibility bars, etc.)
- Disinfectant mats at entries



Keeping Doctors and Patients at a Distance

- Doing virtual rounds with one doctor in the room and others connected via videoconference outside
  - Potential use of video cameras for caregivers
- In ICUs, IVs and monitors positioned outside the room so nurses can check patients' status without unnecessary exposure for both

Barcroft Media via Getty Images

Jon Gerberg/The Washington Post)

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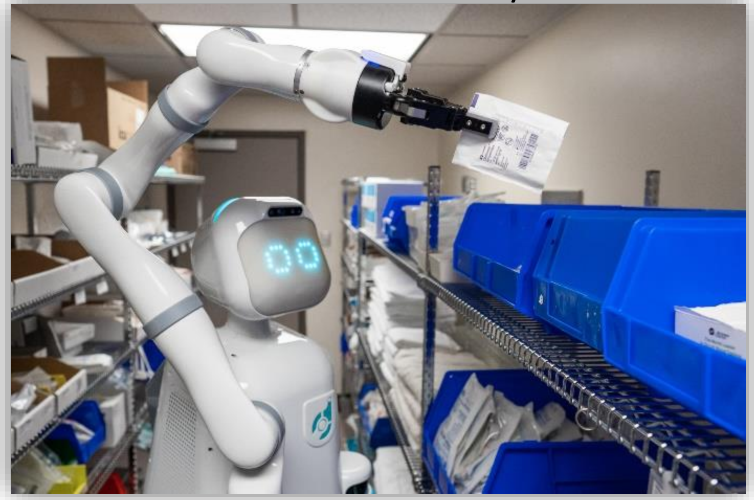
Keeping Doctors and Patients at a Distance

- Computerized Robots
  - Telehealth visits to patient rooms enable doctors to have more-frequent visits with patients because they don't need to take time to don and doff protective equipment
- "Mechanized helpers" to provide more service in hospital wards
- Robots to perform tasks that take nurses away from direct patient care, such as fetching and delivering medications and supplies to patient rooms and handling lab samples

Flavio Lo Scalzo/Reuters



Orissa Post

Move to a Broader Telehealth Model

- Technology will be the catalyst, but it must be applied strategically
  - Augmented reality
  - Artificial intelligence-enabled technology,
  - Precision medicine; and,
  - Virtual care support
- The combination of increased data gathering and artificial intelligence to make the society more resilient to disease spread

Discussion

6. **Comments from the Public/Committee Members on issues not on this agenda**

Facilitator: David Bliss, Committee Chair (or designee)

The board will receive comments from the Public/Committee Members. Matters raised at this time may be taken under consideration for placement on a subsequent agenda.